Developing Mathematical Thinking for Young Children

Current Research Findings and Implications

Early Year Conference 2014

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INITIATIVE FOR DEVELOPING MATHEMATICAL THINKING

Questions for today:

- Why is early mathematics important?
- What do we know now that we did not know 10-15 years ago?
- How can we support young children's learning of mathematics?

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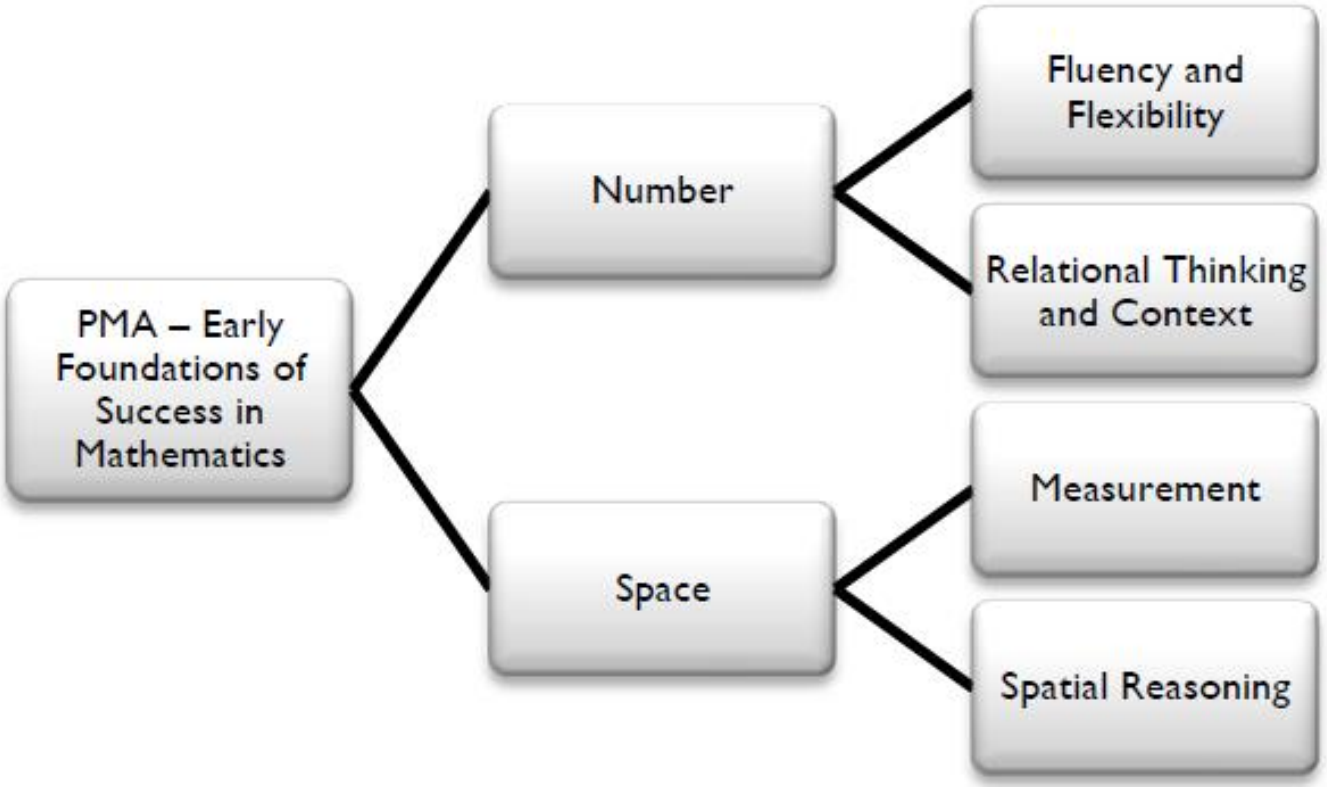
Primary Math Assessment
PreK-2nd grade

Figure 1. Overview of PMA constructs.



Brendefur et al., 2011; 2012

Why is early mathematics important?

- Mathematically proficient young children:
  - Pass standardized achievement tests at a higher rate in grades 3-12 than children who are less proficient
  - Have higher levels of literacy skills than students who demonstrate early literacy ability
  - Achieve at a higher rate than their less proficient peers in middle school and high school math classes, particularly high school algebra
  - Earn a greater income as adults than less proficient children (often attributed to a greater level of post-secondary education)
  - Profess a very high level of satisfaction with their personal lives and careers in adulthood

Brendefur et al. 2011; 2012; Clements & Sarama, 2007; Duncan et al. 2007; Rivera-Batiz, 1992; Wolfgang, Stannard & Ithel, 2001

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What do we know now that we did not know 10-15 years ago?

- Gender differences found in older children and adults' math ability are less evident in young children
- Teachers and parents can improve young children's math ability by creating opportunities to engage in mathematical activity
- Early childhood educational programs emphasizing problem-solving, spatial reasoning tasks and mathematical relationships have a greater impact on learning than those emphasizing rules and procedures

Brendefur et al. 2011; Clements & Sarama, 2007; Duncan et al. 2007; Lempke et al., 2004; NRC, 2001; Wolfgang, Stannard & Ithel, 2001

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How can we support young children's learning of mathematics?

- Picture 5 blocks (all cubes) in front of you. If you were asked to stack the 5 blocks into a tower, how would you begin?

Brendefur et al., 2011; 2012

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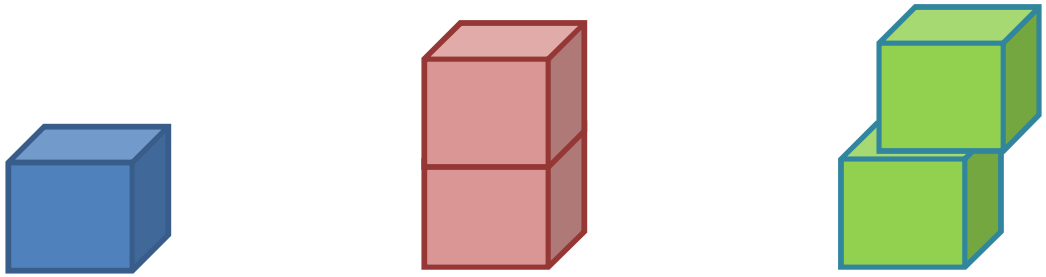

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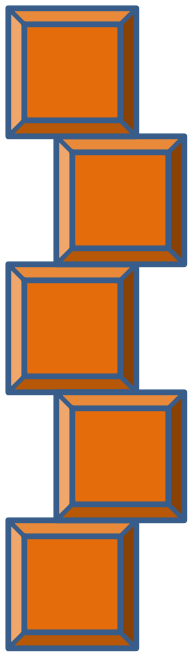
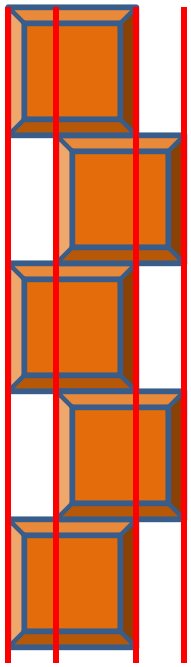
Why do spatial relations matter?



3 + 2 =___+ 1

Early Conceptions of Equality and Proportion

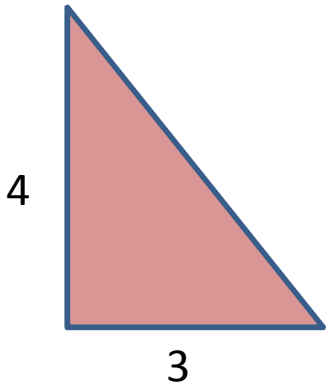


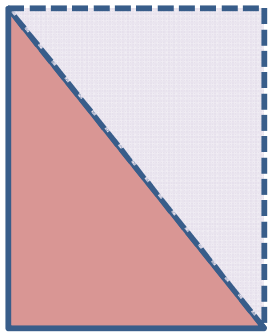
3 + 2 =___+ 1

(Brendefur et al. 2011; 2012; Hanline, Milton & Phelps, 2001; Wolfgang et al., 2001)

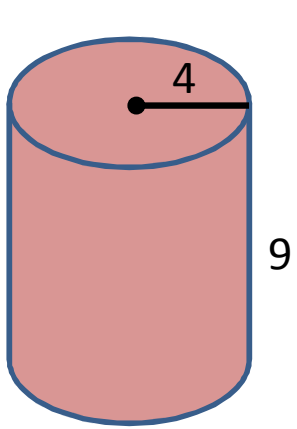
Spatial Relations: Making Sense of Formulas

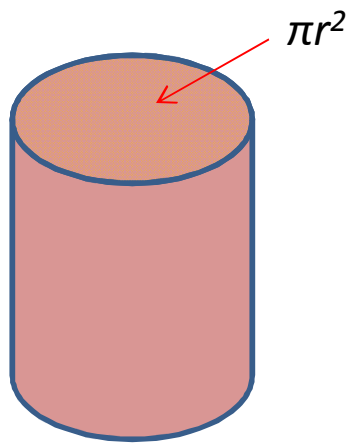
$A = 1/2bh$

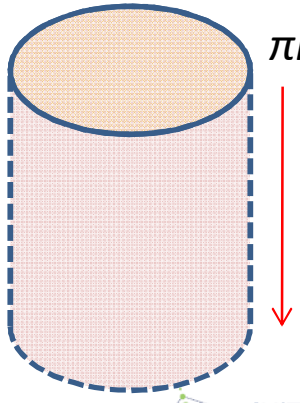




$V = \pi r^2 h$







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Building Spatial Reasoning

GEOMETRY TASKS

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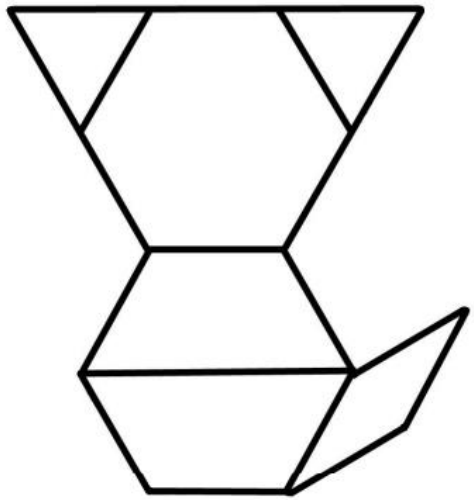
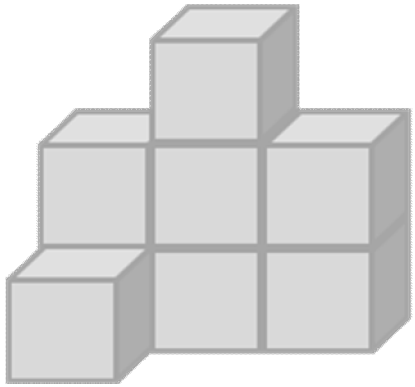
Two Geometry Tasks

Å Pattern Block Mats



Å Perspective Drawings



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Pattern Block Mats

- Use the pattern blocks to cover the outline on the pattern block mat.
- Graph the number of each type of pattern block you used on a line plot.
- Trade with a partner and try to cover the pattern block mat using their graph as a guide to the pieces you can use.
- *Young children should engage in composing and decomposing geometric figures in the way you did when you covered the pattern block mat.*

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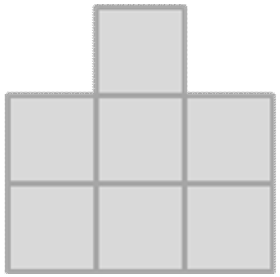
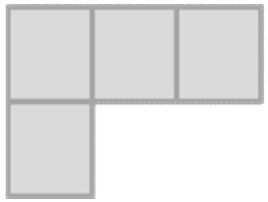
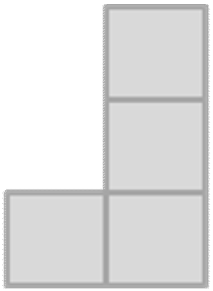
Perspective Drawings



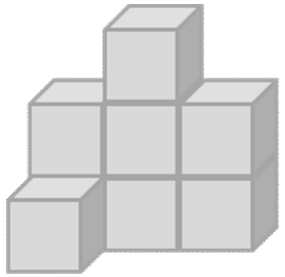
Front



Top



Side



Perspective Drawings

- Create your own model of a building using 10 cubes.
- Draw multiple views of the building and challenge peers to re-create it (using just your drawings)

- **Outcomes:** students simultaneously practice counting, increase their quantitative reasoning ability, and develop their spatial reasoning skills.

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Important Models and Experiences

CONNECTING MEASUREMENT AND NUMBER CONCEPTS

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Bar Model

- Construct/Draw the number 132 using the fewest bar model units below.
- Find another way to build a bar model for 132 using units of 1, 10 and 100.

- *Young children should be encouraged to organize their models (physical and visual) in ways that will allow them to make comparisons and relate magnitudes of quantities.*

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Bar Model

- Draw the following numbers using the fewest bar model units.

  12, 13, 14 and 21, 31, 41

Explain the difference between place value.

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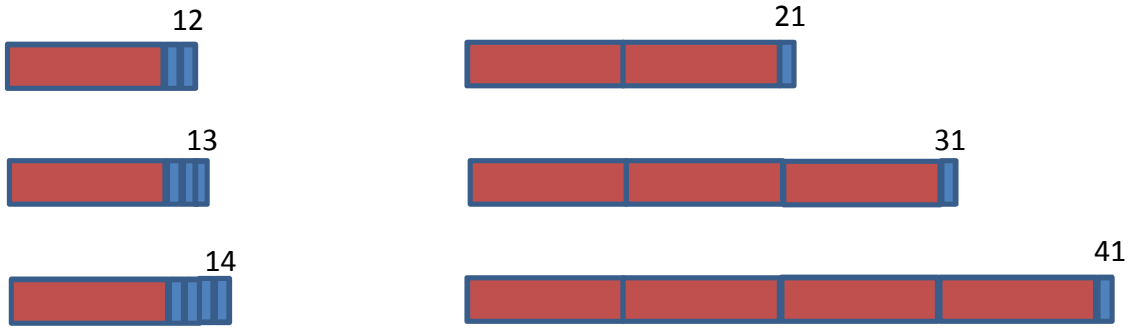

Questions?

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